

What is claimed is:

1. A digital device capable of recharging a rechargeable battery comprising;  
a consuming current detect unit for detecting a consuming current input to the  
digital device;  
5 a control unit;  
a recharging current detect unit for detecting the battery recharging current as the  
battery is recharged; and  
a recharging control unit for regulating the consuming current to the rechargeable  
battery in proportion to a control signal output from the control unit and the battery  
10 recharging current detected by the recharging current detect control unit.
2. The digital device capable of recharging a rechargeable battery according to  
claim 1, wherein the control signal includes a pulse width modulation signal.
- 15 3. The digital device capable of recharging a rechargeable battery according to  
claim 2, wherein the pulse width module control signal has a duty ratio adjusted  
according to the consuming current detected by the consuming current detect unit.
- 20 4. The digital device capable of recharging a rechargeable battery according to  
claim 1, wherein the consuming current detect unit comprises:  
a first current detecting resistor for detecting the consuming current; and  
a first operational amplifier, wherein a first end of the first current detecting  
resistor is coupled to an inverting input of the first operational amplifier and the second  
end of the first current detecting resistor is coupled to the non-inverting input of the first  
25 operational amplifier.
5. The digital device capable of recharging a rechargeable battery according to  
claim 1, wherein the recharging current detect unit comprises:

a second current detecting resistor;  
a third current detecting resistor for detecting the rechargeable battery recharging current; and

a second operational amplifier, wherein a first end of the second current detecting resistor is coupled to a non-inverting input of the second operational amplifier and to the negative terminal of the rechargeable battery, and a first end of the third current detecting resistor is coupled to an inverting input of the third operational amplifier, and further wherein the second end of the second and third current detecting resistors are coupled together to earth ground.

6. The digital device capable of recharging a rechargeable battery according to claim 1, wherein the recharging control unit comprises:

an integrator, an input of which is coupled to a first output of the control unit;  
a third operational amplifier;

a fourth current detecting resistor; and  
a transistor, wherein a first output of the integrator is coupled to a non-inverting input of the third operational amplifier, an inverting input of the third operational amplifier is coupled to an output of the recharging current detect unit, a first end of the fourth current detecting resistor is coupled to an output of the third operational amplifier and a second end of the fourth current detecting resistor is coupled to a first input of the transistor, a second input of the transistor is coupled to a power source, and an output of the transistor is coupled to a positive terminal of the rechargeable battery.

7. The digital device capable of recharging a rechargeable battery according to claim 1, wherein the control unit includes a microprocessor.

8. A method for controlling a digital device to recharge current of a rechargeable battery comprising:

detecting a consuming current input to the digital device;  
detecting a battery recharging current as the battery is recharged; and  
regulating the consuming current to the rechargeable battery in proportion to a  
control signal and the detected battery recharging current

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9. The method for controlling recharging current of a rechargeable battery  
according to claim 8, wherein control signal is a pulse width modulation signal.

10. The method for controlling recharging current of a rechargeable battery  
10 according to claim 8 further comprising:  
adjusting the control signal according to the detected consuming current.

11. The method for controlling recharging current of a rechargeable battery  
according to claim 8, further comprising:  
15 displaying a recharging complete message if the recharging current equals a  
predetermined value.

12. The method for controlling recharging current of a rechargeable battery  
according to claim 10, wherein the step of adjusting the control signal according to the  
20 detected consuming current comprises:

determining whether the magnitude of the consuming current increases or  
decreases; and

varying the pulse width modulation signal duty cycle in accordance with the  
increase or decrease of the magnitude of the consuming current.

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13. The method for controlling recharging current of a rechargeable battery  
according to claim 8, further comprising:  
outputting a control signal according to a magnitude of the consuming current.

14. The method for controlling recharging current of a rechargeable battery according to claim 8, wherein the step of outputting a control signal according to a magnitude of the consuming current comprises:

- 5        maintaining the pulse width modulation duty cycle substantially at a first constant for a first range of consuming current values;  
         maintaining the pulse width modulation duty cycle substantially at a second constant for a second range of consuming current values; and  
         varying the pulse width modulation duty cycle linearly from about the first  
10      constant to about the second constant, for a third range of consuming current values.

15. The method for controlling recharging current of a rechargeable battery according to claim 13, wherein the first constant is in the range of about 50 to about 60 percent duty cycle.

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16. The method for controlling recharging current of a rechargeable battery according to claim 13, wherein the second constant is in the range of about 20 to about 30 percent duty cycle.

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17. The method for controlling recharging current of a rechargeable battery according to claim 13, wherein the first range of consuming current values is in the range of at or about 0 milliamps to at or about 275 milliamps.

18. The method for controlling recharging current of a rechargeable battery  
25      according to claim 13, wherein the second range of consuming current values is in the range of about 950 milliamps to about 1200 milliamps.

19. The method for controlling recharging current of a rechargeable battery

according to claim 13, wherein the third range of consuming current values is in the range of about 275 milliamps to about 950 milliamps.

20. A method for recharging a rechargeable battery in a digital device  
5 comprising:  
determining whether the battery voltage is greater than 5 volts, and if so,  
determining that the battery is partially discharged and performing a recharge operation  
according to the state of the digital device being used.

10 21. The method according to claim 20 wherein the step of performing a recharge  
operation according to the state of the digital device being used comprises;  
determining the consuming current;  
outputting a control signal according to the consuming current; and  
supplying a portion of the consuming current according to the pulse width  
15 modulation control signal to the rechargeable battery for recharging.

22. The method according to claim 21 wherein the control signal includes a pulse  
width modulation signal.

20 23. The method according to claim 22 wherein the step of supplying a portion of  
the consuming current according to the pulse width modulation control signal to the  
rechargeable battery comprises;

determining whether the battery recharging current is between approximately  
1000 and 300 milliamps, and if so, illuminating an illumination device at least one time;  
25 and

determining if the recharging current reaches 300 milliamps within 12 hours, and  
if so, switching to a second recharge mode.

24. The method according to claim 22 wherein the step of switching to a second recharge mode comprises:

charging the rechargeable battery for substantially one hour at a recharging current of less than or equal to 300 milliamps and illuminating the illumination device  
5 for substantially one hour; and

illuminating the illumination device continuously after the first time period has elapsed.

25. The method according to claim 21, further comprising:

10 determining that the rechargeable current does not reach 300 milliamps within 12 hours, and checking the battery voltage; and

determining whether the battery voltage is greater than 7 volts, and if so, illuminating an illumination device continuously.

15 26. The method according to claim 25, further comprising:

determining that the battery voltage is less than or equal to 7 volts; and displaying an error message and terminating the recharge.

27. The method according to claim 20, further comprising:

20 determining that the battery voltage is less than or equal to 5 volts; and charging the battery for approximately 2 seconds at about 80 milliamps; and determining whether the battery voltage is more than 5 volts, and if so, performing a quick recharge, otherwise performing a trickle recharge.

25 28. The method according to claim 27, wherein performing the trickle recharge comprises:

supplying approximately 80 milliamps to the battery for approximately one-half hour and illuminating the illumination device momentarily; and

determining whether the battery voltage is greater than approximately 5 volts approximately one half hour after of recharging, and if so, performing a recharge operation according to the state of the digital device being used.

- 5           29. The method according to claim 28 wherein the step of performing a recharge operation according to the state of the digital device being used comprises;  
              determining the consuming current;  
              outputting a pulse width modulation control signal according to a magnitude of  
              the consuming current; and  
10           supplying a portion of the consuming current according to the pulse width modulation control signal to the rechargeable battery for recharging.

30. The method according to claim 29 wherein the step of supplying a portion of the consuming current according to the pulse width modulation control signal to the  
15 rechargeable battery comprises;  
              determining whether the battery recharging current is between approximately 1000 and 300 milliamps, and if so, illuminating an illumination device at least one time;  
              and  
              determining if the recharging current reaches 300 milliamps within 12 hours, and  
20 if so, switching to a second recharge mode.

31. The method according to claim 30 wherein the step of switching to a second recharge mode comprises:  
              charging the rechargeable battery for substantially one hour at a recharging  
25 current of less than or equal to 300 milliamps and illuminating the illumination device for substantially one hour; and  
              illuminating the illumination device continuously after the first time period has elapsed.

32. The method according to claim 28, further comprising:  
determining that the rechargeable current does not reach 300 milliamps within 12  
hours, and checking the battery voltage; and  
5 determining whether the battery voltage is greater than 7 volts, and if so,  
illuminating an illumination device continuously.

33. The method according to claim 32, further comprising:  
determining that the battery voltage is less than or equal to 7 volts; and  
10 displaying an error message and terminating the recharge.

34. The method according to claim 27, further comprising:  
determining that the battery voltage is less than or equal to approximately 5 volts  
within approximately one half hour; and  
15 determining whether the recharge current is not more than approximately 30  
milliamps for approximately 2 seconds, and if not, continuing to recheck the magnitude  
and duration of the trickle recharge and if so, displaying an error message and  
terminating the recharge.